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Potato Gene Resources

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Distribution of Seed Germplasm from Plant Gene Resources of Canada

Dr. Axel Diederichsen
Plant Gene Resources of Canada
Agriculture and Agri-Food Canada
Saskatoon, SK

Three Research Centres of Agriculture and Agri-Food Canada share the responsibility for the active genebank work in plant genetic resources for food and agriculture in Canada: (1) Plant Gene Resources of Canada (PGRC) at the Saskatoon Research Centre, Saskatoon, Saskatchewan, preserves all seed germplasm, has the central seed storage vaults and maintains the Germplasm Resource Information Network, Canada (GRIN-CA) database that allows national and international clients and the general public to inspect and access the Canadian genebank holdings; (2) the Canadian Clonal Genebank (CCGB) at the Greenhouse and Processing Crops Research Centre, Harrow, Ontario, preserves fruit germplasm; and (3) the Potato Gene Resources Repository (PGRR) at the Potato Research Centre, Fredericton, New Brunswick, preserves potato germplasm. The mandate of PGRC in Saskatoon and the other locations is to acquire, preserve and evaluate the genetic diversity of cultivated plants and their wild relatives with emphasis on germplasm of economic importance or potential for Canada. The germplasm holdings of PGRC and the associated locations currently include 110,444 accessions covering 47 botanical families, 258 genera and 1,036 botanical species. The cereals barley, oat and wheat account for more than 80% of all germplasm holdings. In germplasm of these crops and their wild relatives, PGRC is one of the major genebanks world-wide. It is important for Canada, on a global scale, to improve efficiency in preserving this germplasm for future generations, through International cooperation with other national genebanks and organizations such as the Global Crop Diversity Trust and the Food and Agriculture Organization of the United Nations.

Main deliverables of any genebank are: (1) ensuring efficient conservation of genetic diversity to prevent genetic erosion; (2) providing viable and diverse germplasm for germplasm enhancement, research and sustainable development of the agricultural sector; and (3) generating, documenting and providing relevant information associated with the germplasm to support its efficient utilization. Correct botanical identification of the genebank material to the species level and often to specific groups within the species is important to communicate diversity and PGRC cooperates with taxonomists in order to ensure this.

Canada

All germplasm deposited at PGRC, CCGB and PGRR is distributed under a Standard Material Transfer Agreement (SMTA) that needs to be signed by any germplasm recipient. This SMTA is part of the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture to which Canada and about 130 other countries are signatories. All germplasm in the stewardship of the national genebanks of participating countries is part of the so-called Multilateral System of Access and Benefit Sharing. This mechanism allows access to diverse germplasm world-wide and thereby ensures food security. At the same time it supports preservation and development of genetic diversity in the on-farm sector and in genebanks world-wide by sharing benefits arising from use of genebank material.

PGRC at Saskatoon handles the distribution of seed germplasm from the Canadian national genebank. Germplasm requests are made via the Internet-accessible database GRIN-CA or by contacting PGRC staff directly. An amount of approximately 100 seeds per requested genebank accession is shipped, as the purpose is to provide the genebank client with a small and representative sample of the genetic diversity of the material. In large-seeded material (e.g., beans), the amount of seeds may be lower. The seed samples for shipment are taken from packages in the PGRC seed vault for medium term storage kept at +4°C and a relative air humidity of 20% (Figure 1).

Figure 1. Dallas Kessler gathers seed packages in the storage vault of Plant Gene Resources of Canada.

When shipping seeds internationally, PGRC cooperates with the Canadian Food Inspection Agency to ensure compliancy with phytosanitary requirements. From 2002 to 2013, PGRC shipped annually an average of seed samples of 3,800 genebank accessions to clients. There was some fluctuation in the annual number of samples shipped (Figure 2). PGRC made an average of 106 shipments per year serving clients in about 24 different countries (Figure 3). Of the 45,673 germplasm accessions shipped by PGRC from 2002 to 2013, 66% were sent to clients within Canada and 15% to clients in the United States. Clients in China were the third largest group (3% of shipments) followed by clients from a combined 54 other countries on all continents. These figures underline how interwoven the exchange of germplasm is internationally. These seed shipments do not include the additional 32,000 accessions that were shipped to the Svalbard Global Seed Vault in Norway and partly to the United States Department of Agriculture for long-term storage as security back-up samples in case the original samples preserved at PGRC should ever become compromised due to catastrophic events.

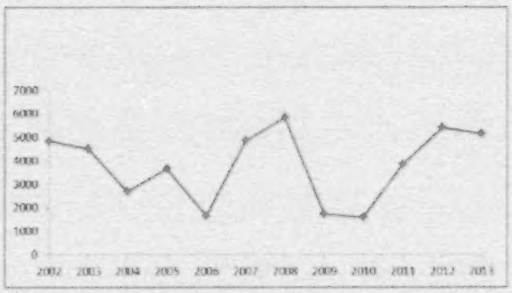


Figure 2. Number of seed samples (accessions) shipped from PGRC per year.

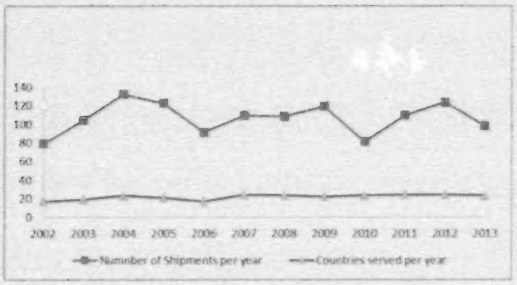


Figure 3. Number of seed shipments made and countries served by PGRC per year.

Genebank clients have different usages for the requested germplasm. Mostly it is plant pathology or chemical quality researchers that request germplasm that then feeds into plant breeding programs. Pure academic researchers are also a significant clientele of PGRC, and molecular researchers have become increasingly interested in particular germplasm accessions including wild crop relatives and exotic material. While there is great value in the rare and desired alleles that the germplasm shipped by PGRC contains, it is important to emphasize that not only the genetic material as such, but also the insights obtained from studying such diversity constitute a very relevant contribution to economic sustainability. The potential of the diversity in the PGRC genebank collection, or any other genebank, can only have an impact on economic and environmental sustainability if genebank clients study and utilize the material. Active work with the PGRC germplasm ensures that new information is generated and new properties are detected that contribute to innovative developments. This is the only way for the germplasm collections to have economic impact. It is not sufficient to rely on the storage aspect of a genebank. Therefore, PGRC strives very actively to manage parts of the collection, engage cooperators and researchers, and to increase the amount of information available about the stored germplasm. This happens in close cooperation with research scientists within Agriculture and Agri-food Canada and with external cooperators at Universities or the industry sector within Canada and abroad.

Recently, Civil Society Organizations have become more engaged in diversity of cultivated plants handled by PGRC and the on-farm sector.

Ensuring access to viable germplasm of genetically diverse material is a complex task. The most challenging step for PGRC is the regeneration of germplasm which is essential for maintaining high seed viability to ensure the genetic integrity of the germplasm, and to have sufficient seed amounts for long-term storage and distribution. The logistics and documentation requirements for the PGRC operation are considerable. Presently, PGRC works in cooperation with partners in the United States and Mexico on upgrading the Internet accessible web site to a system called GRIN-GLOBAL, which will be used by several countries. This system will support access to germplasm and associated information for genebank clients. Techniques for communicating and researching diversity have changed drastically in recent decades. PGRC is steadily adapting to these changes and improving the methods for germplasm conservation and characterization. The core function of the genebank is a long-term commitment as it needs to ensure that knowledge and genetic diversity from the past is preserved. This ensures options for future generations that will also depend on a flexible and adaptable agricultural sector. Genetic diversity is a fundamental requirement for that.

By distributing germplasm, PGRC supports innovation and both economic and environmental resilience within Canada and beyond. *Camelina sativa* is a recent example of a crop that was nearly exclusively preserved in genebanks and only recently has had a resurgence because innovative scientists could obtain viable and diverse seed material from genebanks. Other genebank material infrequently used presently in agriculture may have similar potential. From a Canadian perspective, it is important to understand that most of our

agricultural and horticultural crops were introduced from other parts of the world. However, there are also examples of native Canadian species that are relevant and unique genetic resources such as strawberries, native grapes or some grasses and forage legumes. When Canadian taxpayers invest in a national genebank, they contribute to global efforts in preserving and sharing a cultural heritage to keep options open that in many cases would otherwise be lost.

History and Germplasm Holdings for "Russet Burbank" ("Netted Gem") and its Progenitors

Paul C. Bethke[1], Atef M.K. Nassar[2], Stan Kubow, Yves N. Leclerc[2], Xiu-Qing Li[4], Muhammad Haroon[1], Teresa Molen[4], John Bamberg[5], Max Martin[6] and Danielle J. Donnelly[2,4]

[1] USDA Agricultural Research Service, and University of Wisconsin, Madison, WI
[2]McGill University, Ste. Anne de Bellevue, QC
[3]McCain Foods Canada Ltd., Florenceville, NB
[4]Agriculture and Agri-Food Canada, Fredericton, NB
[5]USDA Agricultural Research Service, Sturgeon Bay, WI and University of Wisconsin, Madison, WI
[6]USDA Agricultural Research Service, Sturgeon Bay, WI

"Russet Burbank" has dominated the frozen French fry sector in North America for decades, yet its origins are not well known. "Russet Burbank" is one of several synonyms for "Netted Gem", its original cultivar name. This article describes the history of "Russet Burbank" ("Netted Gem") and its lineage, and reveals the original finding and release of this sport of "Burbank" in 1902. We also discuss germplasm holdings for "Russet Burbank" and its progenitors and raise concerns about the loss of important heritage cultivars. This is a synopsis of a much longer submission to American Journal of Potato Research (January 2014) by the same authors.

Progenitors of "Russet Burbank"

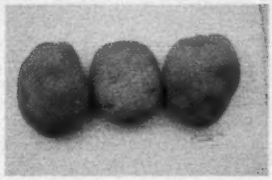
In the 1850s, as a response to the devastating Late Blight epidemic of the 1840s, primitive cultivated potato accessions were imported from South and Central America into USA and Europe in a search for disease resistance and increased fertility. Among landraces from Panama, introduced into the USA by the amateur botanist and potato breeder, Reverend C.E. Goodrich of New York (1851), was "Rough Purple Chili"[1,2]. More than 400 U.S. and European cultivars have "Rough Purple Chili" in their heritage[3]. One very early open-pollinated derivative of "Rough Purple Chili" was the seedling "Garnet Chili", selected by C.E. Goodrich (1857; Figure 1A). An open-pollinated derivative of "Garnet Chili" was "Early Rose" selected by A. Bresee (1867; Figure 1B). Amazingly, when Love[4] examined prominent USA cultivars, all of the 44 most important cultivars with published pedigrees had "Rough Purple Chili", "Garnet Chili" and "Early Rose" in their ancestry.

The discovery of "Burbank" is the stuff of legend. As a young man, Luther Burbank found a rare fruit in a planting of "Early Rose" in his mother's garden in New England (MA)[5]. He monitored this berry as it matured and then looked for it on the ground for several days after it had fallen from the vine. Luther planted the seeds from this berry and selected an exceptional line with white skinned, large smooth tubers (Figure 1C). This line was later sold to a seed company (Messrs. J.J.H. Gregory & Son) which released it in 1876[6] under the name "The Burbank Seedling". Luther Burbank moved to California and sold seed tubers of what came to be known as "Burbank". Performance was excellent, the USDA of that era promoted it heavily, and "Burbank" became very widely grown in USA.

Luther later photographed and commented on a variant line with tubers that looked similar in size and shape to "Burbank"

tubers, but with thick brown (russet) periderm with a netted pattern[5]. One figure caption described these as "Russet Burbanks". In Luther's words "These "Burbank" potatoes raised by Mr. Lou D. Sweet, of Denver Colorado, have somewhat modified their coat in a way that does not add to their attractiveness." Readers over the years have misinterpreted Luther's (rather negative) comments to mean that Lou D. Sweet selected "Russet Burbank". However, while Lou Sweet may have brought it to the attention of Luther Burbank, he never claimed to have discovered it. It is most probable that "Russet Burbank" was not originally a trade name but a description of a "Burbank" with russet skin. Luther Burbank's use of "Russet Burbanks" is consistent with this interpretation. This is supported by an article that describes "the demise of "Burbank" and the comeback of "Burbank" with a russet overcoat"[7].

"Rough Purple Chili" (no picture available)
Imported from S. America, C.E. Goodrich (1851)
Open pollinated – unknown if self-set or hybrid



A) "Garnet Chili"
C.E. Goodrich (1857)
Open pollinated – outcrossed (hybrid)

B) "Early Rose"
A. Bresee (1867)
Open pollinated – outcrossed (hybrid)

C) "Burbank"
L. Burbank (breeder)
Messrs. J.J.H. Gregory & Son (1876)
Mutation (sport)/somatic line

D) "Russet Burbank" ("Netted Gem")
L.L. May & Company (1902)

Figure 1. The lineage of "Russet Burbank" showing its immediate maternal parents and their release dates.

"Netted Gem" has been clearly attributed to the seed distributers, L. L May & Company of St. Paul, MN, by turn-of-the-century researchers in North Dakota[8,9], Ohio[10], and Washington[11]. "May's Netted Gem Potato" was first described in May's Catalogue of Northern Grown Seeds (1902). This included a description of the chance finding in 1895 by an unnamed ranchman in Montana, in a field that the year before had been planted to three potato cultivars, including "Burbank". Many of the characteristics that are associated both historically and currently with "Russet Burbank" (Figure 1D), including early tuber set, high yields, excellent culinary properties, excellent storage, long dormancy and attractive skin were first mentioned in May's catalogue.

Contribution of "Russet Burbank" for Table Stock and Processing

The success of "Russet Burbank" came about for a number of reasons. In the early years, it was promoted by the railways for its size and baking quality[7]. Later, its success was due to the invention of frozen French fries in the US in the 1940's, the start

of Quick Service Restaurant franchises (QSRs) in the 1950's, and the combined expansion of frozen French fry production and QSRs which continues to this day[12]. Used for the dual purposes of fresh market and commercial frozen French fry processing[13,14,15] it has become the most widely grown cultivar in the USA and Canada[13,15,16]. "Russet Burbank" now comprises approximately 70% of the potatoes used for the frozen French fry sector in USA and Canada, respectively, and is also grown for this market in Europe and Australia/New Zealand (Leclerc, pers. com. 2013). Over 40% of the potato growing area (450,000 acres) was planted to "Russet Burbank" in USA in 2012[17]. If we estimate a similar proportion of the 371,713 acres planted to potato in Canada in 2012[18], approximately 149,000 acres would be planted to "Russet Burbank".

Global consumers have internalized this standard for taste and other organoleptic properties following decades of consumption of "Russet Burbank" as baked potatoes and French fries. "Russet Burbank" became the standard for the QSR franchises due to its high yield, high specific gravity, low oil absorption, low sugars, high recovery of excellent grade product and long storability. Since its release in 1902, this cultivar has proven amazingly durable due to its excellent culinary and storage qualities.

Confirmation of Breeding Lineage and Mutant Status of "Russet Burbank"

Felcher[19] genotyped a set of diverse potato cultivars, including "Early Rose", "Burbank", and "Russet Burbank" using 8,303 single nucleotide polymorphisms (SNPs) distributed throughout the potato genome. Individual SNP loci were subjected to a series of quality control filters and SNP genotypes were called using either a diploid model with three marker classes (6373 SNPs) or a tetraploid model with 5 marker classes (3763 SNPs)[20]. "Early Rose" and "Burbank" showed 78.9% identical SNP genotypes using the diploid model and 54.8% identical SNP genotypes using the tetraploid model. At loci where SNP genotype calls were made in both varieties, "Early Rose" and "Burbank" differed at 15.8% of SNP loci using the diploid model and 36.5% of SNP loci with the tetraploid model. Of the 15.8% of SNP loci that differed between the two cultivars, over one third (344 of 1010 SNPs) were homozygous in "Early Rose" but heterozygous in "Burbank". These data support earlier isoenzyme[3,21,22] and Multiplex PCR data[23] (Li and Haroon unpublished 2013) and show that "Burbank" was a hybrid; it did not arise as a self of "Early Rose".

"Burbank" and "Russet Burbank" had identical genotypes at 97.2% of all SNPs using the diploid model and at 94.1% of all SNPs using the tetraploid model. At loci for which a genotype call was made for both "Burbank" and "Russet Burbank", no genotypic differences were observed between the two cultivars with the diploid model and only 0.7% of SNPs differed with the tetraploid model. These data are consistent with published isoenzyme and Multiplex PCR data and strongly support the contention that "Russet Burbank" is a sport of "Burbank" and not a seedling of "Burbank".

Despite the few differences in SNPs between these two cultivars, their phenotypic tuber characteristics are quite different (compare Figure 1C and Figure 1D). These periderm differences are important as the genes for russeting have not yet been identified. Based on assessment of phenotypic characteristics, it seems clear that "Burbank" represents a unique assemblage of recessive traits. It is proposed that a transposon silenced a gene required for russeting in "Burbank" and elimination of this transposon was involved in the mutation from "Burbank" to "Russet Burbank" that restored gene function in the new sport. This phenomenon may not be unique to "Burbank" and its sport, "Russet

Burbank". Maincrop, another white-skinned potato, also related to "Early Rose", came to market in Great Britain in1876. It produced a russet skinned sport called "Golden Wonder" in 1905[24].

Germplasm Holdings of "Russet Burbank" and its Progenitors

Major world repositories were queried about their holdings of "Russet Burbank" and its progenitors. There are relatively few germplasm holdings in world repositories of the original cultivar "Burbank", which is undergoing thermotherapy and meristem tip culture for elimination of PVS at USDA-Sturgeon Bay and is PVX-infected at the INRA repository in Rennes. The USDA and INRA repositories also hold "Garnet Chili", "Early Rose", and "Russet Burbank". The Potato Gene Resources Repository of Canada in Fredericton, NB holds "Garnet Chili", "Early Rose", and "Russet Burbank", with plans to obtain "Burbank". "Early Rose" is held in several other European repositories (Edinburgh, Scotland; Alava, Spain; Alnarp, Sweden and Gross Lüsewitz, Germany) while "Russet Burbank" is held in Edinburgh, Scotland, Gross Lüsewitz, Germany and Donegal, Ireland. The Vavilov Institute in St. Petersburg, Russia holds field-grown tubers of "Early Rose" and "Russet Burbank". The Potato Centre (CIP) in Lima Peru does not hold "Russet Burbank" or its progenitors.

While "Garnet Chili" and "Early Rose" have fared better, "Rough Purple Chili" and numerous other important nineteenth and early twentieth century cultivars have been lost. Heritage cultivars, such as these, are important to maintain even as economic stresses force the consolidation of plant germplasm resources around the world.

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Potatoes and the Arts

Hielke De Jong
Retired Agriculture and Agri-Food Canada
Potato Breeder
Virgil, ON

During its colourful history, the potato has been the object of many forms of art. The earliest known association between the potato and visual arts is found on ceramics created by South American Indian civilizations several centuries ago. Archaeological discoveries from that era in Peru and Bolivia include various kinds of pottery on which the potato is depicted. Various forms of vases were frequently used in religious ceremonies and funeral rites in these Andean regions. Such vessels, filled with different foods, were also placed in graves along with the dead. On occasion such pottery portrayed human figures, but nevertheless with the characteristics of potato tubers such as eyes and knobs (Figures 1 and 2).

Figure 1. Pot (app. 200 A.D.) showing a figure of a person built up of tubers with eyes on face and body. Source: R. N. Salaman. 1970. The History and Social Influence of the Potato.

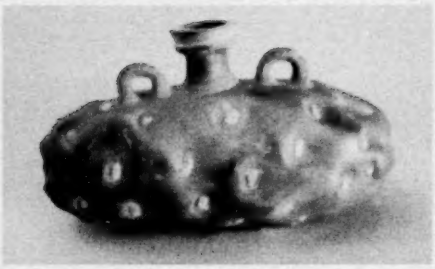


Figure 2. Ceramic storage vessel (A.D. 600-800) modeled on the well-known ancient potato cultivar "Huayro" which is still being grown in the Peruvian Andes. Source: International Potato Center.

When the Spanish invaded Peru, the historian Poma de Ayala, in 1613, described in great detail the various activities of the Inca civilization. This included an agricultural calendar in which he described the various activities in each month of the year. These descriptions were accompanied by hundreds of drawings. One of these drawings shows the harvest of potatoes in the month of June (Figure 3).

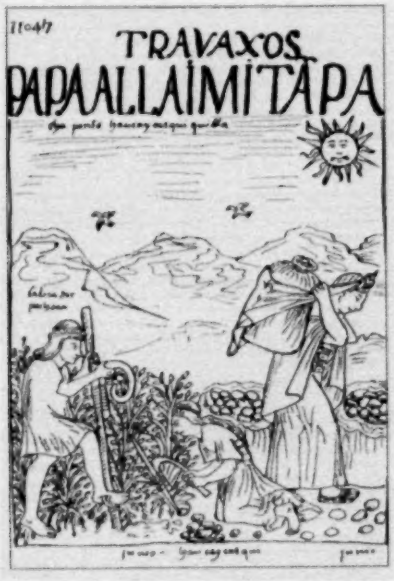


Figure 3. Potato harvest by Incas. Drawing No. 391 by F. G. Poma de Ayala in Nueva Corónica y Bien Gobierno. 1613. Source: J. Reader. 2008. Propitious Esculent. The potato in world history. Heinemann. London.

Thomas Moore, the bard of Ireland, praised the potato in a humorous and somewhat whimsical poem:

I'm a careless potato and care not a pin
How into existence I came;
If they planted me drill-wise or dribbled me in,
To me 'tis exactly the same.
The bean and the pea may more loftily tower,
But I care not a button for them;
Defiance I not with my beautiful flower
When the earth is hoed up to my stem.

In terms of music, the potato has also been featured in several songs in different languages. Perhaps the most favorite Canadian one is by Stompin' Tom Connors *"Bud The Spud."* Here are the lyrics of the first verse:

It's bud the spud from the bright red mud
Rollin' down the Highway smiling-
The Spuds are big on the back of Bud's rig
And they're from Prince Edward Island they're from Prince Edward Island.

Several potato proverbs extol the down-to-earth wisdom of simple farm folk. An American proverb has it that: *A man who prides himself on his ancestry is like the potato, the best part is underground.* And the German farm wisdom translates to: *The dumbest farmer has the biggest potatoes.*

There are many paintings where the potato is the focus. In others, it is part of the background where the respective artist describes the rural way of life. In some of these paintings art and religion are intertwined. Perhaps in no other classical paintings is this relationship expressed stronger than in Vincent Van Gogh's "*The Potato Eaters*" and Jean-François Millet's "*The Angelus.*"

Van Gogh started out by studying theology and subsequently became a missionary to coal miners in Belgium. He was so moved by their poverty that he gave away his possessions, including most of his clothing. However, the church authorities considered

his zeal to be excessive and dismissed him. Vincent in turn rejected institutional religion but nevertheless remained profoundly religious. After the church withdrew its support, Van Gogh used art, instead of preaching, as his mode of religious expression. He began his artistic career by making drawings and paintings of the simple life of the peasants, both at home and at work. He painted several works which displayed their struggle for existence and thus stirred the conscience of society to improve the lot of the poor. Since the potato played such a dominant role in the lives of these people, it is no surprise that many of his paintings involve the potato. They include "*Woman Harvesting Potatoes*," "*Woman Peeling Potatoes*," and "*Basket With Potatoes*." He completed "*The Potato Eaters*" (Figure 4), after several preliminary drafts. Van Gogh's own comments about this painting say it all:

"*I have tried to make it clear how those people, eating their potatoes under the lamplight, have dug the earth with those very hands they put in the dish and so it speaks of manual labour and how they honestly earned their food.*"

Figure 4. Vincent van Gogh. 1885. The Potato Eaters. Source: Wikimedia Commons. In public domain.

Figure 5. Jean-François Millet, 1859. The Angelus. Source: Wikimedia Commons. In public domain.

Millet's painting of the "*L'Angelus*" (Figure 5) has even more obvious religious overtones. The Angelus was a centuries-old prayer custom which was initiated (often three times a day – morning, noon and evening) by the ringing of the village church bells. In ancient times the ringing of bells was often associated with angelic greetings, hence the name "Angelus." In this painting a man and a woman – humble farm folks – are praying at the end of a day's work in the field. A basket of potatoes stands at the lady's feet and a wheelbarrow loaded with bags (presumably filled with potatoes) is standing at her right. One can almost hear the bells ringing from the church in the distant right.

Hielke De Jong is a retired Agriculture and Agri-Food potato breeder, consultant and co-author of *The Complete Book of Potatoes: What Every Grower and Gardener Needs to Know*.

Annual Report 2013

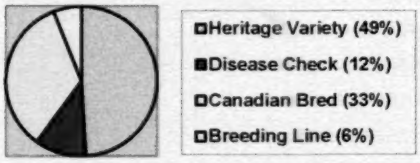
Potato Gene Resources Repository

Teresa Molen

The Collection

1. Holdings

• The Potato Gene Resources Repository contains 167 clones. Of this total, 165 are maintained *in vitro*, and 117 clones were grown for tuber production at our Benton Ridge Potato Breeding Substation, Benton, New Brunswick. A full listing of accessions may be found on the attached request form. The following chart shows the percentage of clones in each Repository category.



2. New Accessions

• Four heritage varieties were accepted into the Repository in 2013. Of these, "Christmas Island Rose", donated by William Higgins of Christmas Island, Nova Scotia, is available for request at this time. The remaining are undergoing virus freeing and *in vitro* establishment before they can be made available. "Christmas Island Rose" is an early to mid-summer variety, yielding tubers with smooth pink to rose colour skin, light to moderate rose colour flesh that are excellent tasting, very mealy and store well.

3. Evaluations

• Twenty-three varieties were grown in an evaluation trial at the Potato Research Centre. Two replications of fifteen hills of the following varieties: "Rose Fin Apple", "Heidzel Blue", "Kroop Neber", "Stella's Newfoundland", "Cupids", "Pink Pearl", "Newfoundland Elephant", "German Butterball", "Congo", "Kerr's Pink", "Shepody", "Peanut", "Sable", "Belle-de-Fontenay", "Red Dutch", "Red Acadian", "Cariboo", "Superior", "Gold Coin", "McIntyre Blue", "Purple Viking", "Austrian Crescent" and "Chieftan". Samples were also taken for Total Glycoalkaloid (TGA) Analysis, photographs and culinary evaluation.

• Twenty-seven clones were grown in twenty hill plots at the Benton Ridge Potato Breeding Substation, Benton, NB, to provide material for demonstration and cooking quality evaluation throughout the winter and spring.

4. Management

• Passport data for 167 PGR accessions is available online at the Genetic Resources Information Network-Canadian Version (GRIN-CA). GRIN-CA may be accessed through the Plant Gene Resources of Canada web site http://pgrc3.agr.ca/.

• Disease testing was conducted for new *in vitro* accessions and clones which have been maintained *in vitro* for five years. Thirty-six clones were grown in the greenhouse and tested twice in 2013. All clones were negative for PVA, PLTV, PotLV, PVS, PVX and PVY. Results for PSTV and BRR are pending. Extra mini tubers from the greenhouse grow out will be offered to PGR clients in the spring of 2014.

• All *in vitro* clones were screened for bacterial and fungal contamination using Potato Dextrose Broth and Richardson's Broth, twice during 2013. All clones Currently in the Repository are negative for these contaminants.

• A total of 1075 microtubers were harvested from 166 of the PGR clones in 2013. Approximately half of the microtubers were sent to Saskatoon in October 2013 to be stored as back up at Plant Gene Resources of Canada, AAFC. The viability of the Repository is protected by this remote location storage arrangement. Dallas Kessler, of Plant Gene Resources Canada, Saskatoon SK, continues to monitor and evaluate the microtubers. The remaining microtubers are stored at the Repository.

5. Distribution

• Twenty requests for 507 clones were received in 2013. Of this number, 85 clones were distributed as *in vitro* plantlets, 330 clones as field grown tubers, and 92 clones as greenhouse grown mini tubers. "Banana", "Bauer Grun Rote Auge", "Early Ohio", "Garnet Chili", "German Butterball", "Glenwood Red", "Heidzel Blue", "Irish Cobbler", "Peanut", "Red Dutch" and "Russet Burbank" were the most requested accessions in 2013.

Distribution of Clones by Purpose – 2013

Purpose of Request	Number of requests	Clones	*In vitro* plantlets	Field tubers	Mini-tubers
Research	15	326	57	195	74
Teaching or Demonstration	2	40	0	40	0
Conservation	3	141	28	95	18
Total	20	507	85	330	92

Requests by Destination – 2013

Destination	Number of requests
Newfoundland and Labrador	1
Nova Scotia	1
New Brunswick	8
Quebec	1
Ontario	4
Alberta	3
USA	2
Total	20

Five-Year Compilation of Clone Distribution for Potato Gene Resources 2009 – 2013

Year	Research	Education	*Conservation	Total	Field tubers or mini-tubers	*In vitro* plantlets	Micro-tubers	Total
2009	9	48		57	311	203	141	655
2010	4	15		19	295	171	0	466
2011	6	3	23	32	456	212	0	668
2012	20	2	7	29	806	172	0	978
2013	15	2	3	20	422	85	0	507
Total	54	70	33	157	2290	843	141	3274

*This category of clone request was added in 2011.

Repository Items of Interest

Communication

• In addition to the requests for clones, many requests for information about the Repository, the availability of clones, clone descriptions and pedigrees, and techniques for handling *in vitro* material were received throughout 2013.

• The annual Potato Gene Resources newsletter has a distribution list of 300 recipients and is made possible with the administrative support of Ms. Sylvie LaForest.

• The current newsletter and several back issues may be accessed on the Weekly Checklist of Government of Canada Publications. Browse for the newsletter by title at:
http://publications.gc.ca/

Meetings and Miscellaneous Information

• Dr. Benoit Bizimungu, curator of the potato genetic resources, participated in the annual Technical Advisory Committee (TAC) meeting of the USDA potato genebank NRSP6 project, held at Sturgeon Bay, WI, June 25-26, 2013. Information on the genebank and minutes of TAC meetings can be found at the genebank web site:
http://www.ars-grin.gov/nr6/

• New international standards for Plant Genetic Resources were recently adopted by FAO's Commission on Genetic Resources for Food and Agriculture. A number of experts, including Dr. Bizimungu, from national programs and other international and regional organizations contributed in preparation of these international standards aimed to help genebanks worldwide conserve plant diversity in a more efficient and cost-effective manner. Additional information can be found at the web link:
http://www.fao.org/agriculture/crops/thematic-sitemap/theme/seeds-pgr/gbs/en/.

Displays

• Posters and accessions were displayed at the Benton Ridge Potato Breeding Substation Open House on July 24, 2013.

Research Scientist and Germplasm Curator, Dr. Benoit Bizimungu and Potato Gene Resources Technician, Teresa Molen during a display at Benton Ridge.
Photo by John Morrison, AAFC.

Visitors

• January 9, 2013 – Dr. Jeanne Jacobs, potato genetics and genomics researcher from Plant and Food Research in New Zealand.

• January 21, 2013 – Delegation from the Dominican Republic.

• July 18, 2013 – Bob Perry, Fundy Gardeners, Saint John, NB.

• July 26, 2013 – Members of AUSVEG, the National Industry Body for vegetable and potato growers in Australia.

• October 24, 2013 – Dr. Siddika Mithani, Assistant Deputy Minister, Science and Technology Branch, AAFC and Dr. Christiane Deslauriers, Director General, Coastal Ecozones.

Members of The Canadian Food Inspection Agency (CFIA) (left) accompany delegates from the Dominican Republic through a tour of the Repository given by Dr. Benoit Bizimungu (right). Photo by Teresa Molen, AAFC.

(Left to right) Research Scientist/Germplasm Curator, Dr. Benoit Bizimungu, Dr. Christiane Deslauriers, Director General, Coastal Ecozones, Dr. Siddika Mithani, Assistant Deputy Minister, Science and Technology Branch, AAFC and Research Scientist, Dr. Bernie Zebarth. Photo by Wayne Riley, AAFC.

Potato Research Centre Web Site

•http://www.agr.gc.ca/researchcentre/fredericton offers an overview of the mandate, resources and achievements of the Centre. The research studies being conducted at the Centre as well as the staff associated with those studies is highlighted. Links to the Potato Research Network and to other agriculture- and potato-related web sites are also available.

Plant Gene Resources of Canada

• Plant Gene Resources of Canada (PGRC), the national Canadian genebank, preserves, characterizes and distributes plant genetic resources for food and agriculture. PGRC is based on collaboration between AAFC Research Centres and people dedicated to preserving the genetic diversity of crop plants and their wild relatives. PGRC plays a significant part of AAFC's commitment to the Canadian Biodiversity Strategy in response to the Convention on Biological Diversity and the International Treaty on Plant Genetic Resources.

• The Plant Gene Resources of Canada (PGRC) web site located at http://pgrc3.agr.ca/ includes information on the PGRC multi-nodal system of germplasm conservation in Canada and allows searching for germplasm information on the Genetic Resources Information Network-Canadian version (GRIN-CA). Dr. Axel Diederichsen, Research Scientist and Curator at PGRC can be contacted at the Saskatoon Research Centre of AAFC at axel.diederichsen@agr.gc.ca.

The Repository and the Seed Potato System

• The Potato Gene Resources Repository provides *in vitro* plantlets and greenhouse or field tubers for breeding, research and heritage preservation. While extensively tested for freedom from disease, the plantlets and tubers distributed by the Potato Gene Resources Repository are produced

outside the Canadian Seed Certification System and are not eligible for certification.

• The Canadian Seed Potato Certification System operates under the *Seeds Act* and its regulations. Certification begins with tested plantlets established *in vitro* in a facility accredited for this task by the Canadian Food Inspection Agency. The plantlets are used to produce greenhouse tubers which then go to the field in a limited generation system, at each step meeting strict standards specified in the regulations. More information on potato seed certification can be found at the following web site: http://www.inspection.gc.ca/plants/seeds/eng/1299173228771/1299173306579

Potato Gene Resources Newsletter

• The Potato Gene Resources Newsletter is an annual publication of the Potato Gene Resources Repository, Potato Research Centre, AAFC.

• The Newsletter provides information on potato germplasm in the Repository and on issues related to the genetic diversity in the potato. The opinions expressed by authors may not necessarily represent the views of AAFC.

Help us Reduce our Paper Usage

• The Potato Gene Resources Newsletter is available as an electronic version. If you are still receiving a paper version and wish to receive future Newsletters by e-mail, in pdf (portable document format), please send your e-mail address to: Teresa.Molen@agr.gc.ca. We will continue to send the printed Newsletter to those who do not ask to receive it electronically. Maintaining contact with you is important.

Personnel of the Potato Gene Resources Repository and Potato Breeding Program Potato Research Centre

Benoit Bizimungu - Potato Breeder and Germplasm Curator
Agnes Murphy – Plant Pathologist
Teresa Molen – Potato Gene Resources Technician
Stephen Allaby – Potato Breeding Technician
Deborah Campbell – Potato Breeding Technician
Jean-Louis Deveau – Potato Breeding Technician
Denise LeBlanc – Potato Breeding Technician
Cynthia Murray- Potato Breeding Technician
Esther Tremblay-Deveau – Potato Breeding Technician
Donna Wilson - Plant Pathology Technician
Andrew Gardner – Supervisor – Greenhouse
John Gillan – Greenhouse Person
Sylvia Holder – Greenhouse Person
John MacDonald – Greenhouse Person

TO RECEIVE THE NEWSLETTER, PLEASE CONTACT:

Teresa Molen
Editor, Potato Gene Resources Newsletter
Tel: 506-460-4484, Fax: 506-460-4377
Email: Teresa.Molen@agr.gc.ca

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